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Possibility of Egg Shell Powder as Replacement in Soil Stabilization

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ABSTRACT- This report describes a research of the qualities of soil stabilised using lime and egg shell powder. Tests were carried out to evaluate the possibility of egg shell powder in substituting lime, which can make the whole stabilisation process more cost-effective and environmentally benign. The results demonstrate that all of the treated mixtures outperformed the untreated soil in terms of strength. Egg shell powder was added to the soil in amounts of 0.5%, 1%, 1.5%, and 2% by weight. Replacement of up to 50% of the lime used for stabilisation was tested. It was discovered that replacing 25% of the lime with egg shell powder provided higher strength qualities and may be used in practise.

KEYWORDS- Lime, Soil stabilization, Egg shell, improvement, Geotechnical, replacement.

I. INTRODUCTION

Any land-based construction needs a solid foundation to sustain the entire structure, which is why it is so crucial. The soil around the foundation is crucial to the foundation's strength. So, in order to work with soils, we must first understand their qualities and the variables that influence their behavior.

Soil stabilization is the practice of adding natural or synthetic elements to soil to improve its qualities. It is typically used to modify and improve low-quality materials, resulting in changes in soil properties such as a lower rate of subsidence, a lower adhesion coefficient in soils with high cohesion (clay), an increased adhesion coefficient in soils with low cohesion (sand), a lower percentage of water absorption and prevention of soil expansion, and a lower cost of earth structures (transport), accelerated road building activities, frost and defrost resistance, enhanced ductility, decreased stiffness of earth structures, absence of weed development on the top of earth structures such as highways, and reduced bearing layer thickness Stabilizing fine soil using additions that enhance soil qualities through physical and chemical changes is among the most frequent techniques of fine soil improvement.

Soil property improvement is essential in the present environment since soils with the requisite qualities are not easily available for construction operations. Numerous difficulties have been reported when structures were built on weak and soft soils, such as shear failure, excessive settlement, differential settlement, and so on. The only options left to us are to enhance the soil at the site to make it appropriate for the estimated load or to use a deep foundation. Adoption of a deep foundation is not a financially viable solution. As a result, improving soil qualities and in-situ soil treatment are becoming extremely relevant. Soil stabilization is a cost-effective solution to one of the most difficult building issues. Researchers from all around the world have investigated several materials that may be used with soil to improve soil qualities. (Basha, 2005) investigated soil stabilization with rice husk ash and cement. Brooks (2009) performed stabilization experiments on the use of fly ash and rice husk ash. (Kamon, 1991) investigated soil stabilization utilizing lime and industrial wastes. (Paul, 2014) investigated soil stabilisation with egg shell powder and quarry dust. (Anoop S P, 2017) performed research on soil improvement using lime and elephant dung strips. Lime was discovered to be the most often utilized and efficient stabilizer in all of the many tests undertaken throughout the world. Lime is not an industrial waste or by-product; the production of lime demands temperatures in the range of 750° C, which contributes to the fact that stabilizing vast areas of soil with lime alone will raise the cost of stabilization. This study attempts to replace lime with egg shell powder and determines the extent to which lime may be replaced by egg shell powder without sacrificing strength.

Because of its comparable chemical makeup, egg shell powder is a suitable material to substitute lime in the stabilization process. As with lime, the main ingredient in egg shell powder is calcium carbonate. Egg shells are discarded in large numbers by hotels, restaurants, and other establishments and they are now confronting disposal issues. The utilization of egg shell powder in soil stabilization avoids the disposal issues caused by egg shell generations. Furthermore, powdering egg shell is simple. Egg shell powder production does not generate CO2 as does lime production, which involves heating to 750°C. As a result, using egg shell powder in soil stabilization will make the whole stabilization process more cost-effective, sustainable, and environmentally benign.

(amu.o.o 2005) investigated the influence of egg shell powder on the lime's stabilising potentila on an expanding

clay soil. He ran a series of tests to establish the best percentage of lime and egg shell powder. The perfect amount of lime was slowly replaced with an appropriate amount of egg shell powder. The lime stabilisation at 7% was shown to be superior to the combination of 4% egg shell powder + 3% lime.

(Okonkwo.u.n 2012). investigated the impact of egg shell ash on the strength qualities of cement stabilised lateritic soil. All cement and egg shell ash quantities were calculated as a percentage of dry soil weight. The soil-cement egg shell ash combination was subjected to compaction, california bearing ratio, unconfined compressive strength, and durability tests. The addition of eggshell ash elevated overall optimal moisture content while decreasing the maximum dry density of the soil cements eggshell ash combinations. Also, increasing the eggshell ash component boosted the strength qualities of the soil cement egg shell ash composite by up to 35% on average, but fell short of the strength requirements even though the durability was met.

II. MATERIALS AND PROPORTIONS

The ingredients employed in this investigation include soil, lime, and egg shell powder. The study employed soft clayey soil from the vallur region of the Ongole district in Andhra Pradesh. Lime was obtained from local shops, while egg shells were collected from hotels and restaurants in Ongle local. The gathered egg shells were crushed and ground into powder. This was then sieved using a 75 micron IS sieve to get it down to the fine-grained soil size range.

The ingredients indicated above were blended in varied amounts to examine their influence on soil stability. First, the untreated soil was examined and its strength was determined to determine whether stabilization was required. The optimal lime concentration estimated according to ASTM D 6276 criteria was added to this untreated soil mix. The optimal lime level was discovered to be 4% of soil weight. Then, in the stabilization phase, egg shell powder was included as a substitute for lime. The quantities of lime and egg shell powder were adjusted while keeping the overall amount of replacement constant. Table 1 lists the various blends employed in this investigation.

Table 1: Mix Proportions

Mix Designation	Details
C	Untreated soil
C+.5ESP	Clay +0.5% weight replaced by egg shell powder
C+1 ESP	Clay + 1% weight replaced by egg shell powder
C+1.5ESP	Clay + 1.5% weight replaced by egg shell powder
C+2ESP	Clay + 2% weight replaced by egg shell powder

III. METHODOLOGY

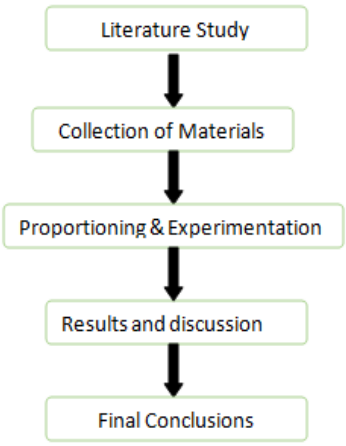

Figure 1: Methodology

IV. RESULTS AND DISCUSSION

The above-mentioned soil mixtures were tested, and the findings are presented in table 2. The unconfined compressive strength of in situ soil was determined to be 0.45 kg/cm2, indicating the need for soil stabilisation. The strength of the soil sample changed dramatically when it was blended with optimal lime concentration. The addition of lime nearly increased the strength.

Table 2: Test Results

Sample	Liquid limit %	Plastic limit %	OMC (%)	γ_d (g/cc)	Mean UCC (kg/cm^2)
C	24	11	18	1.68	0.42
C+0.5ESP	30	12.68	20	1.82	0.82
C+1 ESP	33	13.01	22	1.85	0.90
C+1.5ESP	34	12.9	21	1.78	0.80
C+2 ESP	35	12.9	21	1.75	0.67

The atterberg limits of the soil sample did not vary significantly after the addition of egg shell powder. It was discovered that egg shell powder had no effect on the flow and consistency of the soil sample. Figure 2 depicts the graph of the changing of atterberg limits with the addition of egg shell powder.

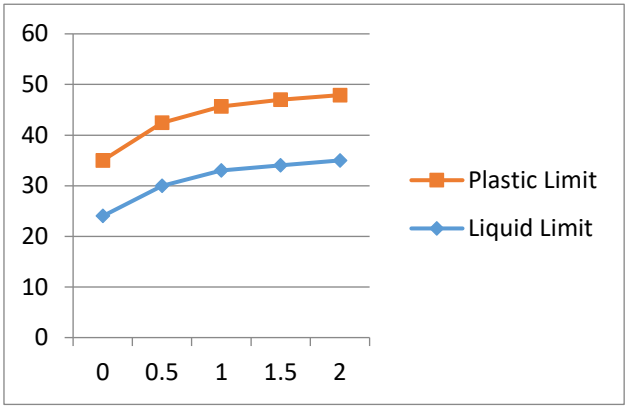

Figure 2: Variation of atterberg limits with Egg shell powder

Compaction experiments revealed a 25% increase in dry density when lime was replaced with egg shell powder. Dry density began to drop after 25% lime substitution with egg shell powder. Because egg shell powder is not as compatible as lime, it could not improve soil qualities when used in sufficient quantities to replace lime. The differences in dry density caused by the addition of egg shell powder to the lime modified mix are seen in Fig.3.

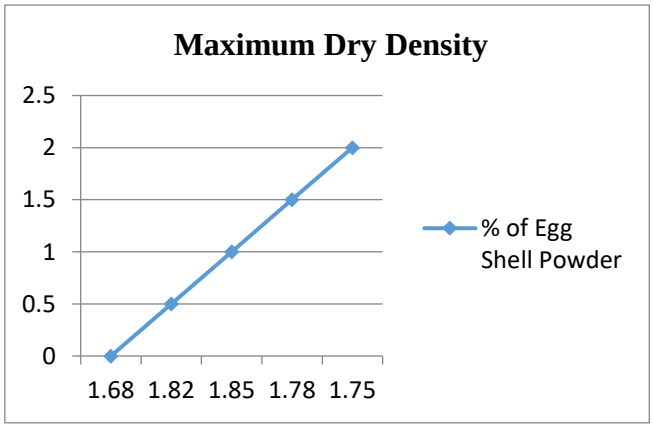

Figure 3: Compaction Test results for different percentages of Eggshell powder

The unconfined compressive strength of each soil mix was determined. The results demonstrate that replacing lime with egg shell powder leads in an improvement in unconfined compressive strength of up to 25%. The strength was shown to deteriorate over this threshold of replacement. The addition of modest amounts of egg shell powder increased the strength of the lime-modified mix. As the replacement % grew, the strength began to decline, as seen in Figure 4. This might be because egg shell powder is not as effective as lime, and adding more egg shell powder will diminish the total lime concentration. The addition of modest amounts of egg shell powder improved the pace at which the pozzolanic reaction occurred, resulting in a greater strength.

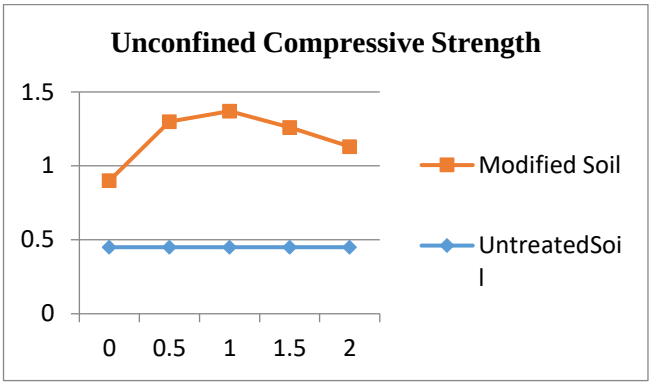

Figure 4: Compressive Strength Test results for different percentages of Egg shell Powder

V. CONCLUSION

Egg shell powder was discovered to be a very excellent substitute for the expensive lime used for soil stabilisation. The use of egg shell powder in soil stabilisation will eliminate egg shell disposal issues while also making the stabilisation process more inexpensive and sustainable. According to the findings of the study, egg shell powder can replace up to 25% of the lime used in the stabilisation process. This substitution also boosted the strength of the treated soil. As a result of its similar chemical compositions and qualities, egg shell powder is a suitable materials to substitute lime in the soil stabilisation process.

REFERENCES

[1] Amu, O. O., A. B. Fajobi, and B. O. Oke. "Effect of eggshell powder on the stabilizing potential of lime on an expansive clay soil." Journal of Applied Sciences 5.8 (2005): 1474-1478.

[2] Bowles, Joseph E. "Physical and geotechnical properties of soils." (1979).

[3] Petry, Thomas M., and Dallas N. Little. "Review of stabilization of clays and expansive soils in pavements and lightly loaded structures—history, practice, and future." Journal of Materials in Civil Engineering 14.6 (2002): 447-460.

[4] Akshaya Kumar Sabat (2012), "Effect of Propylene Fiber on Engineering Properties of Rice husk ash – Lime Stabilized Expansive soil", vol (2012), Bund.t.

[5] HarshitaBairaj, Yadav R.K, Jain .R (2014), "Effect of jute fibers on Engineering Properties of Lime Treated Black Cotton Soil", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, vol 3 issue 2, Feb 2014.

[6] IS 2720 Part – III Section 2 , 1997, "Methods of tests for Soils" , (Specific gravity),BIS , New delhi.

[7] IS 2720 Part – V 1995, "Methods of tests for Soils", (Atterberg limit), BIS ,New delhi. 6. IS 2720 Part – VIII 1997, "Methods of tests for Soils", (Proctor compaction test), BIS ,New delhi.

[8] IS 2720 Part – XVI 1979, "Methods of tests for Soils" , (California Bearing Ratio),BIS New delhi